PROPOSAL TITLE: Improving Guideline-Concordant Antibiotic Administration At UCSF Health: An Order Panel and Decision-Making Tool to Guide Antibiotic Prescribing

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ABSTRACT: Clinicians frequently prescribe antibiotics discordant with guidelines, with a 30-50% performance gap between ideal prescribing and current practice. This exposes patients to the side effects of antibiotics and fosters antibiotic resistance, costing the healthcare system more than $4.6 billion yearly. One intervention that decreases inappropriate antibiotic use and length of therapy is providing guidance regarding appropriate antibiotic prescribing at point-of-prescription, such as order panels in the electronic health record (EHR). Additionally, Infectious Disease Society of America guidelines suggest the development of facility-specific clinical practice guidelines, which includes order sets and order panels, to optimally address antibiotic use. Community-acquired pneumonia (CAP) is a frequently treated infectious condition that has a clearly delineated treatment course to which clinicians frequently do not adhere. Therefore, CAP treatment presents a chance to improve patient care and cut costs. We propose a multidisciplinary approach to education and prescription guidance for clinicians at UCSF Health for CAP by developing and implementing an order panel providing treatment-related education and guidance. Our multifaceted approach includes a pre-intervention survey to optimize clinician buy-in and tailor the order panel to clinician priorities; development of inpatient and outpatient order panels in APeX for treatment of community-acquired pneumonia; monitoring the rate of use of the order panel after rollout; and comparison of duration and selection of antimicrobial therapy for CAP before and after our intervention.

TEAM:

- Allison Bond, MD, MA (Hospital Medicine faculty; project co-lead)
- Waseem Sous, DO (Hospital Medicine HEAL fellow; project co-lead)
- Sarah Doernberg, MD, MAS (Director of Antimicrobial Stewardship)
- Armond Esmaili, MD (Hospital Medicine UBLT Medical Director; project mentor)
- Ripal Jariwala, PharmD (Infectious Diseases Clinical Pharmacist)
- Emily Kaip, PharmD (Infectious Diseases Clinical Pharmacist)
- Raman Khanna, MD (Director of Informatics)

PROBLEM:

- At UCSF, antibiotic treatment for all infectious syndromes besides Clostridioides difficile and sepsis is prescribed via placement of individual antibiotic orders, without suggestions for standard-of-care antibiotic agents or durations. Research has shown that providers err on the side of prescribing a longer duration, and sometimes use broader agents, than is needed.
- On the individual level, this exposes the patient to adverse events related to antibiotics – estimated by some research to affect 20% of patients who receive antibiotics.
- On the population and systems levels, this fosters antimicrobial resistance, of which the threat has never been more imminent. This also creates unnecessary healthcare costs via the cost of the antibiotic(s) and the cost of administering the medication(s). In addition, this is an inefficient process which costs clinicians time and raises the possibility of error, because clinicians who wish to adhere

to institutional guidelines for antimicrobial prescribing must toggle between UCSF Infectious Diseases Management Program (IDMP) guidelines and APeX when ordering treatment.

- Although an inpatient order set pertaining to the treatment of pneumonia exists ("IP Pneumonia"), this is rarely – if ever – used, does not contain decision-making support or education, and does not focus on the antibiotic treatment of CAP. Due to time constraints with regards to data retrieval, we were unable to ascertain exactly how many times (if ever) the order panel has been used in the last year, but the fact that neither the project leads nor the Director of Antimicrobial Stewardship and Informatics were initially aware that this set existed indicates its use is likely very rare.

TARGET:

- Our primary goal is to reduce the duration of antibiotic treatment for community-acquired pneumonia (CAP) to the course that is known to be safe and is considered standard of care.
- Secondary goals include the dissemination of provider education regarding optimal duration of treatment for CAP as per institutional and national guidelines; decreasing antibiotic-associated adverse events (such as acute kidney injury, Clostridioides difficile, and allergic reactions); and decreasing the use of unnecessarily broad antibiotic therapy intended to treat CAP.

GAPS:

- Educational gap: Many clinicians lack awareness of CAP treatment guidelines with regards to antimicrobial selection and/or antibiotic duration.
- Technological gaps: Research shows that even when prescribers are aware and in agreement with antimicrobial prescribing guidelines, they prescribe antibiotics in a way that veer from these guidelines. There is no system in APeX to guide clinicians towards guideline-concordant antibiotic prescribing for the treatment of CAP. When prescribing an antibiotic in APeX, clinicians are required to select the infectious syndrome they intend to treat, but no feedback or guidance is provided regarding optimal treatment.

INTERVENTION:

- Incorporating the major tenets of change management, we will use pre-disposing, enabling, and reinforcing interventions.
- *Predisposing:* Provider survey and expert focus group: We will disseminate a brief survey to inpatient and outpatient providers in the Departments of Medicine, Emergency Medicine, and Surgery to evaluate their knowledge of institutional CAP treatment guidelines and to explore in which ways an order panel may be most relevant to their clinical practice. There has already been high interest in this project from representatives in Divisions and Departments across UCSF Health, including Pediatrics, Pediatrics Infectious Diseases, Emergency Medicine, and Adult Infectious Diseases, and we have a focus group planned with representatives from each of these in attendance to solicit feedback regarding what is needed to guarantee the success of the order panel, as well as to recruit project champions to promote buy-in of the project amongst their colleagues. We already have buy-in and support from Informatics (Raman Khanna) and Antimicrobial Stewardship (Sarah Doernberg).
- *Enabling:* Development of Order Panel: We will submit a proposal to the APeX clinical Content Committee requesting the development of inpatient and outpatient order panels that prompt providers to select the type and duration of antimicrobial agent intended to treat CAP while providing a one-

sentence summary of institutional guidelines and an external link to full institutional guidelines and/or national. The order panel will be activated both if providers attempt to prescribe one of the antibiotics frequently used for pneumonia, e.g. ceftriaxone, and if they type “pneumonia” into orders.

- We will also educate providers across disciplines about the new order panel via media campaign and UCSF Health departmental/divisional champions.
- *Reinforcing:* Post-Rollout Feedback: Based on reductions in excess antibiotic use for CAP, positive institutional feedback regarding cost savings and benefits to patients will be disseminated by department.
- Potential barriers: Development of the APeX order panel would be feasible and straightforward. One key barrier to implementation will include clinician awareness and uptake of an order panel, as the culture at UCSF thus far is to order most things via individual orders. This is the primary reason we anticipate using order panels for this intervention, which are activated when placing standard orders in Epic, rather than order sets, which require tabbing into a separate section of orders in Epic and which are anticipated to have lower clinician uptake. We also plan to address this barrier via our pre-intervention survey.
- Other potential barriers to our intervention could include clinician resistance to use of the order panel if the patient is felt to fall outside of the population of patients for whom antibiotic prescribing guidelines are recommended.

PROPOSED EHR MODIFICATIONS:

- There is currently no order panel or decision-making guide for prescribing antimicrobials for common infectious conditions in Apex; instead, prescribers manually enter the antibiotic type(s), duration, and dosage(s) that they want to use.
- We will add an antibiotic order panel in APeX that would be summoned both if clinicians search for the antibiotic type and the condition they intend to treat. The order panel will include a brief summary of institutional recommendations for antibiotic selection and duration, an external link to full prescribing recommendations, and click-boxes to allow clinicians to select suggested antibiotic type and dosage (including second-line therapies in the case of the presence of antibiotic allergies) and duration.

COST:

- We anticipate that taking into account all inpatients, emergency department (ED) patients, and outpatients treated for CAP at UCSF Health, the cost savings offered by cutting excess antibiotic therapy for CAP will exceed $250,000 per year.
- Our intervention will cut costs primarily via two ways: Decrease in length of stay and cost savings related to antimicrobial therapy.
- *Length of Stay Cost Savings:*
    - One study found that patients admitted to the hospital with CAP who were treated using a pneumonia pathway/order set had a statistically significantly shorter length of stay than patients admitted with CAP who were treated without the order set (**length of stay: 5 days with order set, 6.7 days without**, p = 0.01).

- Cost per day (room and board) for medical/surgical floor inpatients at UCSF Health (per UCSF Finance): **$1,586**
- We were asked to determine how many patients were treated at UCSF Health for CAP after initially providing data on how many patients were treated for all types of pneumonia.
- We reviewed APeX data of patients treated with the antibiotics that are considered standard-of-care for CAP (ceftriaxone, doxycycline, azithromycin, and/or azithromycin) AND for which "lower respiratory tract infection" was listed as the indication when ordered by the clinician on UCSF Health's inpatient services during a one-week period from 1/9/2023 to 1/15/2023.
- We found that 83 patients were treated for CAP during that week in January 2023.
- Based on these data, **4,316 patients are treated for CAP on all inpatient services combined at UCSF Health per year.**
- We appreciate the feedback regarding the length-of-stay-related cost savings. Based on the feedback and the limited literature available regarding reductions in length-of-stay (aside from the study presented above), we have modified the length-of-stay reduction to 0.2 (from 1.7). Based on this adjustment, we anticipate the following:
- Estimated length-of-stay-related cost savings for *all UCSF Health inpatients treated for CAP* in 2022:
  - 4,316 patients x 0.2 days = **863 inpatient days saved**
  - 863 inpatient days saved x $1,586/d = **$1.37M**
- Even if our intervention's effect on length of stay is much smaller than what is found in the literature, cost savings would remain significant.

- *Antimicrobial Therapy Cost Savings:*
  - Cost of CAP treatment per day: Via the UCSF Charge Description Master list, the cost of each day of antibiotic treatment of antibiotics that are standard-of-care for CAP are as follows: Ceftriaxone - $21; azithromycin - $30 (500 mg)/ $18 (250 mg); levofloxacin - $9; doxycycline $48 ($24 per dose).
  - Because various combinations of these antibiotics are used to treat CAP, the **total cost per day of CAP treatment regimens** are:
    - Ceftriaxone with azithromycin (CA): $51
    - Ceftriaxone with doxycycline (CD): $69
    - Levofloxacin (L): $9
  - As above, we estimate **4,316 patients were treated for CAP** on all inpatient services combined at UCSF Health in 2022.
  - Studies have indicated that **2,526 excess days of CAP treatment occur per 1,000 patients hospitalized with pneumonia**. Therefore, we estimate that in 2022, there were 10,902 excess days of CAP treatment among inpatients at UCSF Health**.**

    - Estimated antibiotic-related cost savings for **all inpatient services at UCSF Health treated** with standard regimens for CAP range from $98,118 - $752,238 per year:
        - CA regimen: 10,902 excess antibiotic days x $51/d =$556,002 saved/year
        - CD regimen: 10,902 excess antibiotic days x $69/d = $752,238 saved/year
        - L regimen: 10,902 excess antibiotic days x $9 = $98,118 saved/year
- **Total anticipated cost savings (including length-of-stay and antibiotic-related costs): $1.46M to $2.12M per year**
- **These cost savings are an underestimate as the above includes only UCSF Health inpatients treated for CAP, without accounting for UCSF Health outpatients treated for CAP.** Indeed, treatment courses for CAP may not be accounted for in our prior figure, given there are 2.5 million outpatient visits to UCSF Health each year, and CAP incidence rates in the literature range from 20.6 to 79.9 per 10,000 person-years.
- The cost esimates above were verified with UCSF Finance with the assistance of the Caring Wisely team.
- Additional cost savings mechanisms via this intervention that can be explored decreased use of broader and often more expensive antibiotics (e.g. vancomycin); increased clinician efficiency; decreased medication errors; and/or decreased duration of the administration of intravenous antibiotics.

SUSTAINABILITY:

- Moving forward, we envision expanding our order panel initiative to encompass many other clinical syndromes, including hospital-acquired pneumonia, urinary tract infections, skin and soft tissue infections, intraabdominal infections, meningitis, and neutropenic fever.
- Our intervention will be sustained in part through the permanence of the order panel and through dissemination of clinician education.
- We also have a sustainable plan to keep the order panel up to date:
    - When IDMP guidelines are updated (e.g. when national guidelines change), the leads on this project will be alerted and will liaise with the Informatics team to concomitantly update the order panel. We are already collaborating closely with the UCSF Antimicrobial Stewardship Program (ASP), Informatics team, and the Infectious Diseases Management Program (IDMP). Specifically, the ASP and Informatics teams are aware of and support the project. In addition, the project leads presented this work during an IDMP meeting in April 2023, which the Antimicrobial Stewardship team also attended, where the initiative was well-received. We will continue to gain input from and collaborate with these groups during and after the Caring Wisely year to continuously make updates to the order panel, learn from leaders in informatics and antimicrobial stewardship at UCSF, and ensure that the IDMP guidelines are reflected in the order panel.
    - There has also been multi-departmental interest in this work, which represents the opportunity to foster sustainability by soliciting Divisional/Departmental champions who can communicate with and offer feedback on behalf of their colleagues regarding the order panel. We have convened a multidisciplinary working group to facilitate communication between clinicians from various clinical departments; Informatics; and the ASP about this initiative. Should the project leads be unable to

continue to facilitate updates to the order panel further in the future, another member of the working group will be selected to fill the role.

BUDGET:

- Please see separately attached budget.